GLOSSARY

AASHTO Classification - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway and Transportation Officials.

Acre-Foot - The volume of water that will cover 1 acre to a depth of 1 ft.

Abutment - The part of a valley side (wall) against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment. Right and left abutments are those on respective sides of an observer looking downstream.

Aggregate - (1) The sand and gravel portion of concrete (65 to 75% by volume), the rest being cement and water. Fine aggregate contains particles ranging from 1/4 in. down to that retained on a 200-mesh screen. Coarse aggregate ranges from 1/4 in. up to 11/2 in. (2) That which is installed for the purpose of changing drainage characteristics.

Air Vent - A pipe designed to provide air to the outlet conduit to reduce turbulence and prevent negative pressures during release of water. Extra air is usually necessary downstream of constrictions.

Alluvial Soils - Soils developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes.

Alluvium - A general term for all detrital material deposited or in transit by streams, including gravel, sand, silt, clay, and all variations and mixtures of these. Unless otherwise noted, alluvium is unconsolidated.

Anti-Seep Collar - A projecting collar, usually of concrete, built around the outside of a pipe, tunnel, or conduit under or through an embankment dam to lengthen the seepage path along the outer surface of the conduit.

Anti-Vortex Device - A facility placed at the entrance to a pipe conduit structure, such as a drop inlet spillway or hood inlet spillway, to prevent air from entering the structure when the pipe is flowing full.

Appurtenant Structures or Works - Auxiliary features of a dam, such as outlet, spillway, powerhouse, tunnel, mechanical and electrical equipment, etc.

Apron - A pad of non-erosive material designed to prevent scour holes developing at the outlet ends of culverts, outlet pipes, grade stabilization structures, and other water control devices.

Arch Dam - A concrete or masonry dam that is curved so as to transmit the major part of the water pressure to the abutments.

As-Built Drawings - Plans or drawings portraying the actual dimensions and conditions of a dam, dike, or levee as it was built. Field conditions and material availability during construction often require changes from the original design drawings.

ASTM - American Society for Testing Materials, an association that publishes standards and requirements for materials used in the construction industry.

Atterberg Limits - Method used to describe the consistency of fine-grained soils with varying degrees of moisture content. Depending on the amount of moisture present, fine-grained soils can be categorized by one of four states: solid, semisolid, plastic, and liquid. The Atterberg Limits define the transition between each of these states as: (1) the shrinkage limit, which is the moisture content at which the transition from solid to semisolid state takes place; the plastic limit, which is the moisture content at which the transition from semisolid to plastic state takes place; and the liquid limit, which is the moisture content at which the transition from plastic to liquid state takes place. The **Plasticity Index** is the numerical difference between the liquid limit and the plastic limit of soil, which is the range of moisture content within which the soil remains plastic.

Auxiliary Spillway - See Spillway.

Axis of Dam - The horizontal centerline of a dam in the longitudinal direction.

Backwater - The rise in water surface elevation caused by some obstruction such as a culvert, narrow bridge opening, inefficient channel, dams, buildings or fill material that limits the area through which the water shall flow. Backwater reduces the capacity of a waterway or conduit.

Base Flow - Stream discharge derived from groundwater sources as differentiated from surface runoff. Sometimes considered to include flows from regulated lakes or reservoirs.

Beaching - The removal by wave action of a portion of the upstream (reservoir) side of the embankment and the resultant deposition of this material farther down the slope. Such deposition creates a relatively flat beach area.

Bedrock - The more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.

Benchmark - A marked point of known elevation from which other elevations may be established.

Bentonite - Highly plastic clay consisting of the minerals, montmorillonite, and beidellite that swell extensively wet. Often used to seal soil to reduce seepage losses.

Berm - A horizontal step or bench in the upstream or downstream face of an embankment dam. It is sometimes called a bench.

Blanket - Drainage Blanket - A drainage layer placed directly over the foundation material, typically to control water movement to prevent soil particle migration and erosion. **Blanket Drain** - A drain that extends in a generally horizontal direction (much like a blanket) under a relatively large area of the downstream portion of the embankment, intercepts seepage through the embankment and the foundation, and pre- vents further saturation of the downstream toe. **Grout Blanket** - See Consolidation Grouting. **Upstream Blanket** - An impervious layer placed on the reservoir floor upstream of a dam. In the case of an embankment dam, the blanket may be connected to the impermeable element in the dam.

Boil - A disturbance in the surface layer of soil caused by water escaping under pressure from behind a water-retaining structure such as a dam or a levee. The boil may be accompanied by deposition of soil particles (usually granular) in the form of a cone-shaped ring (miniature volcano) around the area where the water escapes.

Borrow Area - A source of earth fill material used in the construction of embankments or other earth fill structures.

Breach - An opening or a breakthrough of a dam resulting in a release of water. A **controlled breach** is the deliberate, controlled removal of embankment material to release water from the reservoir at a controlled rate. An **uncontrolled breach** is typically caused by rapid erosion of a section of earth embankment by water or other natural, uncontrolled forces.

Buttress Dam - A dam consisting of a watertight upstream face supported at intervals on the downstream side by a series of buttresses.

Cavitation - Wear on hydraulic structures where a high hydraulic gradient is present. Cavitation is caused by the abrupt change in direction and velocity of the water so the pressure at some points is reduced to the vapor pressure and vapor pockets are created. These pockets collapse with great impact when they enter areas of higher pressure, producing very high impact pressures over small areas that eventually cause pits and holes in the surface. Noises and vibrations may be evident during high flows.

Channel - A portion of a natural or artificial watercourse which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. It has a defined bed and banks that serve to confine the water.

Channel Stabilization - Protecting the sides and bed of a channel from erosion by controlling flow velocities and flow directions using jetties, drops, or other structures and/or by lining the channel with vegetation, riprap, concrete, or other suitable lining material.

Chute - A high-velocity, open channel (usually paved) for conveying water down a steep slope without erosion.

Clay - (1) Soil fraction consisting of particles less than 0.002 mm in diameter. (2) A soil texture class that is dominated by clay or at least has a larger proportion of clay than either silt or sand. Clay exhibits the property of cohesion when the moisture content is below the liquid limit and above the plastic limit.

Cofferdam - A temporary structure enclosing all or part of a construction area so that construction can proceed in a dry area. A "diversion cofferdam" diverts a river into a pipe, channel, or tunnel.

Cohesion - Property of unconsolidated fine-grained soil by which the particles stick together by surface forces. Cohesion is a property that permits soil to be molded or rolled into shapes without crumbling.

Cohesive Soil - A sticky soil such as clay or silt exhibiting cohesion; its shear strength is approximately half it unconfined compressive strength. When unconfined, it has considerable strength when air-dried and significant strength when saturated.

Conduit - A closed channel for conveying discharge through, under or around a dam. A pipe and a box culvert are conduits.

Consolidation Grouting (Blanket Grouting) - The injection of grout to consolidate a layer of the foundation, resulting in greater impermeability and/or strength.

Construction Joint - The interface between two successive placings or pours of concrete where a bond, not permanent separation, is intended.

Contour - An imaginary line on the surface of the earth connecting points of the same elevation. May also be called a contour line. Topographic maps are developed to depict contour lines.

Control Section - The component of a spillway which regulates the outflows from the reservoir. A control structure limits or prevents outflows below fixed reservoir levels and regulates releases when the reservoir rises above that level.

Core - The impervious or relatively impervious material forming the central part of a dam or embankment. Where a dam has a core, the outer zones are usually comprised of more pervious materials. Some dams are constructed entirely of a relatively homogeneous, impervious material with no distinct core.

Core Wall - A wall built of impervious material, usually concrete or asphaltic concrete, in the body of an embankment dam to prevent leakage.

Corrosion - The chemical attack on a metal by its environment. Corrosion is a reaction in which metal is oxidized.

Crest Length - The length of the top of a dam, excluding the length of spillway unless otherwise noted, powerhouse, navigation lock, fish pass, etc. where these structures form part of the length of a dam. If detached from a dam, these structures should not be included.

Crest of Dam - The top of a dam (See Top of Dam).

Crest Width or Top Thickness - The thickness or width of a dam at the level of the top of the dam. In general, the term "thickness" is used for gravity and arch dams and "width" is used for other dams.

Crib Dam - A gravity dam built up of boxes, cribs, crossed timbers, or gabions and filled with earth or rock.

Crown of Pipe - The elevation of the top of pipe.

Cross Section - A “cut” across any structure, such as an embankment, to depict the composition or dimensions of the structure at the point of the cross section. It may be a graph or plot of ground elevation across a stream valley or a portion of it, usually along a line perpendicular to the stream or direction of flow.

Culvert - A closed conduit used for the conveyance of water under an embankment, roadway, railroad, canal or other impediment.

Cut - (1) A portion of land surface or area from which earth has been removed or will be removed by excavating. (2) The depth below the original ground surface to the excavated surface.

Cut-and-Fill - The process of earth grading by excavating part of a higher area and using the excavated material for fill to raise the surface of an adjacent lower area.

Cutoff - An impervious construction or material which reduces seepage or prevents it from passing through foundation material.

Cutoff Trench - A long, narrow excavation (keyway) constructed along the center line of a dam, dike, levee, or embankment and filled with relatively impervious material intended to reduce seepage of water through porous strata.

Cutoff Wall - A wall of impervious material (e.g., concrete, asphaltic concrete, steel sheet piling) built into the foundation to reduce seepage under the dam.

Dam - A barrier built for impounding or diverting water. Dams may be constructed to retain normal runoff from streams and land surfaces, flood waters, water pumped from a stream or a well, and mining operations. Off-channel reservoirs may also have a dam to control the water elevation and discharge.

Dam Safety Professional - A dam safety professional is an engineer or geologist with specific expertise in the design, operation, and construction of dams and appurtenant works. A dam safety professional must have specific knowledge with the aspects of the dam under consideration; for example, an engineer or geologist with geotechnical or geological experience would be required to evaluate a slope stability or soil concern. Or, an engineer with hydrologic and hydraulic experience would be required to determine spillway capacity. A dam safety professional is qualified if he/she has specific dam-related experience relevant to the issues or concerns that are present at any particular dam. A qualified dam safety professional is required to supervise and prepare the IDNR Report Form for formal technical inspections on high hazard dams; current IDNR regulations for high hazard dams may require that a professional engineer registered in the state of Indiana make the formal technical dam inspections.

Design Flood - The largest flood that a given project is designed to pass safely. The reservoir inflow-discharge hydrograph used to estimate the spillway discharge capacity requirements and corresponding maximum surcharge elevation in the reservoir.

Design Life - The period of time for which a facility is expected to perform its intended function.

Design Storm - A selected storm event, ranging from a 50% PMP to a full PMP, described in terms of the probability of occurring once within a given number of years, for which dams, drainage or flood control improvements are designed and built.

Dewatering - The removal of water from a reservoir or other area.

Dike - An embankment used to confine, divert, or control water. Often built along the banks of a river to prevent overflow of lowlands; a levee.

Discharge - Usually the rate of water flow. A volume of fluid passing a point per unit time commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, or millions of gallons per day. The rate of water flowing out of a dam.

Divide (drainage) - The boundary between watersheds.

Downstream Toe of Dam - The lowermost portion of the downstream face of a dam where the embankment intersects with the ground surface. For an embankment dam the lowermost portion of the upstream face is the upstream toe.

Drainage Area or Watershed - An area that drains naturally to a particular point on a stream. For dams, the upstream area that drains into the lake, including the lake.

Drainage Layer or Blanket - A layer of permeable material in a dam to relieve pore pressure or to facilitate drainage of fill (see Blanket).

Drainage - The removal of excess surface water or groundwater from land by means of ditches or subsurface drains. Also see Natural Drainage.

Drainage Improvement - An activity within or adjacent to a natural stream or a man-made drain primarily intended to improve the flow capacity, drainage, erosion and sedimentation control, or stability of the drainageway.

Drains - 1) Relief Wells - A vertical well or borehole, usually downstream of impervious cores, grout curtains, or cutoffs, designed to collect and direct seepage through or under a dam to reduce uplift pressure under or within a dam. A line of such wells forms a drainage curtain. 2) A buried slotted or perforated pipe or other conduit (subsurface drain) or a ditch (open drain) for carrying off surplus groundwater or surface water.

Drawdown - The lowering of water surface level due to release of water from a reservoir.

Drop Inlet - A structure in which water enters over a horizontal lip, drops through a vertical or sloping shaft, and then discharges through a conduit to the receiving waters. It is also commonly referred to as a riser in dam construction. A drop inlet typically comprises three components: an overflow control weir, a vertical transition, and a closed discharge channel or conduit. (See Spillway.)

Duration - The time period of a rainfall event.

Embankment Dam (Fill Dam) - Any dam constructed of natural fill materials. **Earth Dam** (Earthfill Dam) - An embankment dam in which more than 50% of the total volume is formed of compacted fine-grained material obtained from a borrow area. **Homogeneous Earthfill Dam** - An embankment dam constructed of similar earth material throughout, except for possible inclusion of internal drains or drainage blankets; distinguished from a zoned earthfill dam. **Rockfill Dam** - An embankment dam in which more than 50% of the total volume comprises compacted or dumped pervious natural or crushed rock. **Rolled Fill Dam** - An embankment dam of earth or rock in which the material is placed in layers and compacted by using rollers or rolling equipment. **Zoned Embankment Dam** - An embankment dam, which is composed of zones of selected materials having different degrees of porosity, permeability, and density.

Emergency Action Plan (EAP) - A formal plan that identifies potential emergency conditions at a dam and outlines the procedures to follow to minimize property damage and loss of life. An EAP is needed to preplan the actions taken by the dam owner, State Emergency Management Agency (SEMA) personnel, and local emergency officials during an emergency. The plan will help provide for timely notification, warning, and evacuation in the event of an emergency; it must be updated and practiced as

conditions dictate. It is up to the dam owner to implement the EAP during an emergency.

Emergency Spillway - See Spillway. Usually a vegetated earth channel used to safely convey flood discharges around an impoundment structure.

Energy Dissipater - A device used to reduce the energy of flowing water to prevent erosion.

Erodibility - Susceptibility to erosion.

Erosion - The wearing away of the land surface by water, wind, ice, gravity, or other geological agents. The following terms are used to describe different types of water erosion: **accelerated erosion** - erosion much more rapid than normal or geologic erosion, primarily as a result of the activities of man; **channel erosion** - an erosion process whereby the volume and velocity of flow wears away the bed and/or banks of a well-defined channel; **gully erosion** - an erosion process whereby runoff water accumulates in narrow channels and, over relatively short periods, removes the soil to considerable depths, ranging from 1-2 ft. to as much as 75-100 ft; **rill erosion** - an erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils (see Rill); **splash erosion** - the spattering of small soil particles caused by the impact of raindrops on wet soils; the loosened and spattered particles may or may not be subsequently removed by surface runoff; **sheet erosion** - the gradual removal of a fairly uniform layer of soil from the land surface by runoff water.

Face - The external surface of a structure, such as the surface of an appurtenance or a dam.

Filter (Filter Zone) - A band or zone of granular material that is incorporated into a dam and is graded (either naturally or by selection) so as to allow seepage to flow across or down the filter without causing the migration of material from zones adjacent to the filter. Filters and associated drains within an earthen embankment permit drainage or removal of liquids to avoid saturation of the downstream toe of the embankment and/or to control underseepage forces, while preventing the removal of finer-sized particles. Filters associated with erosion protection on slopes of dams or in channel linings prevent the removal of finer-sized particles by wave action or turbulence from beneath the larger-sized material (see blanket drain, and vertical or sloping filter).

Filter Blanket - A layer of sand and/or gravel designed to prevent the movement of fine-grained soils.

Filter Fabric - See Geotextile Fabric.

Flapgate - A device that allows liquids to flow in only one direction in a pipe. Backflow preventers are used on outlet pipes to prevent a reverse flow during flooding situations.

Flashboards - Individual lengths of timber, concrete, or steel anchored to the crest of a spillway to raise the retention water level but which may be quickly removed in the event of a flood either by a tripping device or by deliberately designed failure of the flashboard or its supports. To provide adequate spillway capacity, the flashboard must be removed before the floods occur, or they must be designed or arranged so that they can be removed while being overtoppped

Flood or Flood Waters - A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow, the unusual and rapid accumulation, or the runoff of surface waters from any source.

Flood Frequency - A statistical expression of the average time period between floods equaling or exceeding a given magnitude. For example, a 100-year flood has a magnitude expected to be equaled or exceeded on the average of once every hundred years; such a flood has a 1% chance of being equaled or exceeded in any given year. Often used interchangeably with "recurrence interval".

Flood Peak - The highest stage or greatest discharge attained by a flood event, thus peak stage or peak discharge.

Flood Routing - The determination of the attenuating effect of storage on a flood passing through a valley, channel, or reservoir.

Flood Stage - The stage at which overflow of the natural banks of a dam or a stream begins.

Floodway - The channel of a river or stream and those portions of the flood plains adjoining the channel which are reasonably required to efficiently carry and discharge the peak flow of the 100-yr flood of any river or stream.

Flume - A constructed channel lined with erosion-resistant materials used to convey water on steep grades without erosion.

Foundation Drain - A pipe or series of pipes that collects groundwater from the foundation of a dam or the footing of structures to improve stability.

Foundation of Dam - The natural material on which the dam structure is placed.

French Drain - A drainage trench backfilled with a coarse, water-transmitting material; may contain a perforated pipe.

Gabion - A hollow cage or basket, usually of heavy wire, filled with stones or rock and used as a revetment or other protective device to sustain a wall, embankment, or channel.

Gallery - (a) A passageway within the body of a dam or abutment; hence the terms "grouting gallery", "inspection gallery", and "drainage gallery". (b) A long and rather narrow hall; hence the following terms for a power plant: "valve gallery", "transformer gallery", and "busbar gallery".

Gate - A device in which a leaf or member is moved across the waterway from an external position to control or stop the flow. **Bulkhead Gate** - A gate used either for temporary closure of a channel or conduit to empty it for inspection or maintenance or for closure against flowing water when the head difference is small, e.g., a diversion tunnel closure. Although a bulkhead gate is usually opened and closed under nearly balanced pressures, it nevertheless may be capable of withstanding a high pressure differential when in the closed position. **Crest Gate** (Spillway Gate) - A gate on the crest of a spillway to control overflow or reservoir water level. **Emergency Gate** - A standby or reserve gate used only when the normal means of water control is not available. **Fixed Wheel Gate** (Fixed Roller Gate, Fixed Axle Gate) - A gate having wheels or rollers mounted on the end posts of the gate. The wheels bear against rails fixed in side grooves or gate guides. **Flap Gate** - A gate hinged along one edge, usually either the top or bottom edge. Examples of bottom-hinged flap gates are tilting gates and fish belly gates, so-called due to their shape in cross section. **Flood Gate** - A gate to control flood release from a reservoir. **Guard Gate** (Guard Valve) - A gate or valve that operates fully open or closed. It may function as a secondary device for shutting off the flow of water in case the primary closure device becomes inoperable, but is usually operated under balanced pressure, no-flow conditions. **Outlet Gate** - A gate controlling the outflow of water from a reservoir. **Radial Gate** (Tainter gate) - A gate with a curved upstream plate and radial arms hinged to piers or other supporting structures. **Regulating Gate** (Regulating Valve) - A gate or valve that operates under full pressure and flow conditions to throttle and vary the rate of discharge. **Slide Gate** (Sluice Gate) - A gate that can be opened or closed by sliding it in supporting guides.

Gage - (1) A device for measuring precipitation, water level, discharge, velocity, pressure, temperature, etc. (2) A measure of the thickness of metal.

Geotextile Fabric - A woven or non-woven, water-permeable synthetic material used to trap sediment particles, prevent the clogging of aggregates with fine grained soil particles, or as a separator under road aggregate. It is also used as a filter.

Geotextile Liner - A synthetic, impermeable fabric used to seal impoundments against leaks.

Gradation - The distribution of the various sized particles that constitute sediment, soil, or other material, such as riprap.

Grade - (1) The slope of a road, a channel, or natural ground. (2) The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared to a design elevation for the support of construction, such as paving or the

laying of a conduit. (3) To finish the surface of a canal bed, roadbed, top of embankment, or bottom of excavation, or other land area to a smooth, even condition.

Gradient - (1) A change of elevation, velocity, pressure, or other characteristics per unit length. (2) Slope.

Grading - The cutting/or filling of the land surface to a desired slope or elevation.

Grassed Waterway - A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses and used to safely conduct surface water from an area.

Gravity Dam - A dam constructed of concrete and/or masonry that relies on its weight for stability.

Groin Area - The area at the intersection of either the upstream or downstream slope of an embankment and the valley wall or abutment.

Ground Cover (horticulture) - Low-growing, spreading plants useful for low-maintenance landscape areas.

Grout - A thin cement mortar used to fill voids, fractures, or joints in masonry, rock, sand and gravel, and other materials. As a verb it refers to filling voids with grout. Grout is usually applied under pressure.

Grout Curtain (Grout Cutoff) - A narrow barrier produced by injecting grout into a vertical zone, through the embankment, into the foundation to reduce seepage under a dam; or a grout barrier injected into the foundation before the dam is constructed.

Head - (1) The height of water above any plane of reference. (2) The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit would have to fall to release the average energy possessed. Used in various compound terms, such as pressure head or velocity head.

Head Loss - Energy loss due to friction, eddies, changes in velocity, elevation, or direction of flow.

Headwater - (1) The source of a stream. (2) The water upstream from a structure or point on a stream.

Homogeneous Earthfill - An embankment-type construction of more or less uniform earth materials throughout, except for possible inclusion of internal drains or blanket drains. The term is used to differentiate from a zoned earthfill embankment.

Hydraulic Jump - The abrupt rise in water surface that may occur in an open channel or stilling basin when water flowing at high velocity is retarded or suddenly slowed down.

Hydrograph - A graphic representation of discharge from a reservoir, or runoff from a watershed with respect to time for a particular point.

Hydrologic Cycle - The circuit of water movement from atmosphere to earth back to the atmosphere through various stages or processes, such as precipitation, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Hydrology - The science of the behavior of water in the atmosphere, on the surface of the earth, and underground. A typical hydrologic study is undertaken to compute flow rates associated with specified flood events.

Hydromulching - The process of applying mulch hydraulically in a water medium.

Hydroseeder - The machine/equipment used to disseminate seed hydraulically in a water medium. Mulch, lime, and fertilizer can be incorporated into the sprayed mixture.

Impervious - Not allowing infiltration.

Impoundment - Generally, an artificial water storage area, such as a reservoir, pit, dugout, sump, etc.

Inclinometer (Inclometer) - An instrument, usually consisting of a metal or plastic tube, inserted in a drill hole and a sensitized monitor either lowered into the tube or fixed within the tube. This measures at different points the tube's inclination to the vertical. By integration, the lateral position at different levels of the tube may be found relative to a point, usually the top or bottom of the tube, assumed to be fixed. The system may be used to measure settlement.

Infiltration - Passage or movement of water into the soil.

In situ - In the natural or original position. With respect to dams, in situ usually refers to the existing, undisturbed earth. For example, in situ spillways are spillways constructed within undisturbed ground, usually adjacent to the embankment fill. May be used as one word, “insitu.”

Intermittent Stream - A stream that does not maintain water in its channel throughout the year; it normally stops flowing at various times of the year.

Internal Erosion - See Piping.

Inundation Map - A map delineating the area that would be inundated in the event of a dam failure.

Invert - The inside bottom of a culvert or other conduit.

Karst - Topography formed over limestone, dolomite, or gypsum and characterized by sinkholes, caves, and underground drainage.

Keyway - A cutoff trench dug beneath the entire length of a dam to cut through soil layers that may cause seepage and possible dam failure. A keyway may also refer to benches excavated on existing ground for the purpose of creating a stable interface between the existing ground and fill placed in an embankment.

Laminar Flow - Flow at relatively slow velocity in which fluid particles slide smoothly along straight lines everywhere parallel to the axis of a channel or pipe.

Leakage - Uncontrolled loss of water by flow through a hole or crack. See Seepage.

Levee (Dike) - A long, low embankment usually built to protect land from flooding. If built of concrete or masonry the structure is usually referred to as a floodwall. The term "dike" is commonly used to describe embankments that block areas on a reservoir rim that are lower than the top of the main dam.

Lining - With reference to a canal, tunnel, shaft, or reservoir, a coating of asphaltic concrete, reinforced or unreinforced concrete, shotcrete, rubber or plastic to provide watertightness, prevent erosion, reduce friction, or support the periphery of the structure. May also refer to the lining, such as steel or concrete, of an outlet pipe or conduit.

Low-Level Outlet (Bottom Outlet or Sluiceway) - An opening at a low level from a reservoir generally used for emptying or for scouring sediment and sometimes for irrigation releases.

Loam - A soil textural classification in which the proportions of sand, silt, and clay are well balanced. Loams have the best properties for cultivation of plants.

Low Head Dam - A dam of low height (usually less than 15 feet) made of timbers, stone, concrete or some combination thereof that extends across a stream or channel.

Masonry - A dam constructed mainly of stone, brick, or concrete blocks that may or may not be joined with mortar. A dam having only a masonry facing should not be referred to as a masonry dam.

Mean Depth - (1) Average depth. (2) Cross-sectional area of a stream or channel divided by its surface or top width.

Mean Velocity - Average velocity of a stream flowing in a channel or conduit at a given cross section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the reach.

Mulch - A natural or artificial layer of plant residue or other materials covering the land surface which conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations.

Nappe - The lower surface, or underside, of a free falling stream of water, usually over a dam crest or weir.

National Geodetic Vertical Datum of 1929 (NGVD 1929) - The nationwide, Federal Elevation datum used to reference topographic elevations to a known value.

Natural Drainage - The flow patterns of stormwater run-off over the land in its pre-development state.

Non-cohesive Soil - Cohesionless soil consisting of single-grained or honeycombed particles that exhibit low shear strength when dry, and low cohesion when wet. Sand and gravel are examples of a non-cohesive soil.

Normal Depth - Depth of flow in an open conduit during uniform flow for the given conditions.

Normal Water Level (Normal Pool Level) - For a reservoir with a fixed overflow, the lowest crest level of that overflow. For a reservoir whose outflow is controlled wholly or partly by movable gates, siphons or other means, it is the maximum level to which water may rise under normal operating conditions, exclusive of any provision for flood surcharge.

Nutrient(s) - 1) A substance necessary for the growth and reproduction of organisms. (2) In water, those substances (chiefly nitrates and phosphates) that promote growth of algae and bacteria.

Outfall - The point, location, or structure where wastewater or drainage discharges from a pipe or open drain to a receiving body of water.

Outlet - An opening through which water can be freely discharged from a reservoir, or the point of water disposal from a stream, river, lake, tidewater, or artificial. Used to drawdown the reservoir level in dams. Also referred to as a reservoir drain.

Outlet Channel - (Discharge Channel) A waterway constructed or altered primarily to carry water from man-made structures, such as dam spillways, smaller channels, tile lines, and diversions.

Overland Flow - Consists of sheet flow, shallow concentrated flow and open channel flow. The flow of stormwater runoff across the ground surface.

Parapet Wall - A solid wall built along the top of a dam for ornament, for the safety of vehicles and pedestrians, or to prevent overtopping.

Peak Discharge - The maximum instantaneous flow from a given storm condition at a specific location.

Percolation - The movement of water through soil.

Percolation Rate - The rate, usually expressed as inches per hour or inches per day, at which water moves through the soil profile.

Perennial Stream - A stream that maintains water in its channel throughout the year.

Permeability (soil) - The quality of a soil that enables water or air to move through it. It also refers to the rate at which water moves through soil. Usually expressed in centimeters per second, inches per hour or inches per day.

Permeability Rate - The rate at which water will move through a saturated soil. Permeability rates are classified as: **very slow** - less than 0.06 in./hr.; **slow** - 0.06 to 0.20 in./hr; **moderately slow** - 0.20 to 0.63 in./hr; **moderate** - 0.63 to 2.0 in./hr; **moderately rapid** - 2.0 to 6.3 in./hr; **rapid** - 6.3 to 20.0 in./hr; **very rapid** - more than 20.0 in./hr.

Permittivity - The volumetric flow rate of water per unit cross-sectional area per unit head under laminar flow conditions, in the normal direction generally through a geotextile.

Pervious Zone - A part of the cross section of an embankment dam comprising material of high permeability.

pH - A numerical measure of hydrogen ion activity, the neutral point being 7.0. All pH values below 7.0 are acid, and all above 7.0 are alkaline.

Phosphorus (available) - Inorganic phosphorus that is readily available for plant growth.

Phreatic Surface - The free surface of ground water at atmospheric pressure.

Physiographic Region (province) - Large-scale unit of land defined by its climate, geology, and geomorphic history, and therefore uniform in physiography.

Piezometer - An instrument for measuring pore water pressure within soil, rock, or concrete. The piezometric water surface is the water level in a piezometer.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam discharging water that contains soil particles. Water in the soil carries the fine soil particles away, and a series of eroded tubes or tunnels develop. These openings will grow progressively larger and can cause a dam failure.

Plunge Pool - A basin used to dissipate the energy of flowing water. Usually constructed to a design depth and shape. The pool may be protected from erosion by various lining materials.

PMP - Probable maximum precipitation event. A PMP is defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of the year.

Pore Pressure - The interstitial pressure of water within a mass of soil, rock, or concrete. Pore pressure is a result of the height of water above the point of measurement.

Porosity - The volume of pore space in soil or rock.

Principal Spillway - A dam spillway generally constructed of permanent material and designed to regulate and discharge water from the reservoir.

Pressure Relief Pipes - Pipes used to relieve uplift or pore pressure in a dam foundation or in the dam structure.

Qualified Dam Safety Professional - See Dam Safety Professional.

Rainfall Intensity - The rate at which rain is falling at any given instant, usually expressed in inches per hour.

Rational Method - A means of computing storm drainage flow rates (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the rainfall intensity and A is the drainage area.

Reach - The smallest subdivision of the drainage system, consisting of a uniform length of open channel. Also, a discrete portion of river, stream or creek. For modeling purposes, a reach is somewhat homogeneous in its physical characteristics.

Receiving Stream - The body of water into which runoff or effluent is discharged.

Recharge - Replenishment of groundwater reservoirs by infiltration and transmission from the outcrop of an aquifer or from permeable soils.

Recurrence Interval - A statistical expression of the average time between floods equaling or exceeding a given magnitude.

Relief Well - See Drains.

Reservoir – Any impoundment or potential impoundment created by a dam. A natural or artificially created pond, lake or other space used for storage, regulation or control of

water. May be either permanent or temporary. The term is also used in the hydrologic modeling of storage facilities.

Reservoir Area - The surface area of a reservoir when filled to controlled retention water level.

Reservoir Surface - The surface of a reservoir at any level.

Retention - The storage of stormwater to prevent it from leaving the development site. May be temporary or permanent.

Retention Facility - A facility designed to completely retain a specified amount of stormwater runoff without release except by means of evaporation, infiltration or pumping. The volumes are often referred to in units of acre-feet. Dams are retention facilities.

Revetment - Facing of stone or other material, either permanent or temporary, placed along the edge of a stream to stabilize the bank and protect it from the erosive action of the stream. Also see Riprap.

Rill - A small intermittent watercourse with steep sides, usually only a few inches deep.

Riprap - A layer of large stones, broken rock, boulders, or precast blocks placed in random fashion on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against waves, ice action, and flowing water. Very large riprap is sometimes referred to as armoring. Revetment riprap is material graded such that: (1) no individual piece weighs more than 120 lbs; and (2) 90-100% will pass through a 12-inch sieve, 20-60% through a 6-inch sieve, and not more than 10% through a 1 1/2-inch sieve.

Riser - The inlet portions of a drop inlet spillway that extend vertically from the conduit to the water surface.

Rockfill Dam - See Embankment Dam.

Runoff - That portion of precipitation that flows from a drainage area on the land surface, in open channels, or in stormwater conveyance systems.

Sand - (1) Soil particles between 0.05 and 2.0 mm in diameter; (2) a soil textural class inclusive of all soils that are at least 70% sand and 15% or less clay.

Saturation - In soils, the point at which a soil or aquifer will no longer absorb any amount of water without losing an equal amount.

Scour(ing) - The clearing and digging action of flowing water, especially the downward erosion caused by discharge from a dam spillway, or stream water in washing away mud and silt from the stream bed and outside bank of a curved channel.

Scarp - The nearly vertical, exposed earth surface created at the upper edge of a slide or slough, or a beached area along the upstream slope.

Sediment - Solid material (both mineral and organic) that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.

Sedimentation - The process that deposits soils, debris and other materials either on the ground surfaces or in bodies of water or watercourses.

Sediment Delivery Ratio - The fraction of the soil eroded from upland sources that actually reaches a stream channel or storage reservoir.

Sediment Discharge - The quantity of sediment, measured in dry weight or by volume,

consists of both suspended load and bedload.

Sediment Pool - The reservoir space allotted to the accumulation of sediment during the life of the structure.

Seepage - The interstitial movement of water that may take place through a dam, its foundation, or its abutments. The slow percolation (or oozing) of a fluid through a permeable material. A small amount of seepage will normally occur in any dam or embankment that retains water. The rate will depend on the relative permeability of the material in and under the structure, the depth of water behind the structure, and the length of the path the water must travel through or under the structure.

Seedbed - Soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

Settling Basin - An enlargement in the channel of a stream to permit the settling of debris carried in suspension.

Silt - (1) Soil fraction consisting of particles between 0.002 and 0.05 mm in diameter; (2) a soil textural class indicating more than 80% silt.

Silt Fence - A fence constructed of wood or steel supports and either natural (e.g. burlap) or synthetic fabric stretched across area of non-concentrated flow during site development to trap and retain on-site sediment due to rainfall runoff.

Slide - The movement of a mass of earth and/or rock down a slope. In embankments and abutments, this involves the separation of a portion of the slope from the surrounding material.

Slope - Degree of deviation of a surface from the horizontal, measured as a numerical ratio or percent. Expressed as a ratio, the first number is commonly the horizontal distance (run) and the second is the vertical distance (rise) - e.g., 2:1. However, the preferred method for designation of slopes is to clearly identify the horizontal (H) and vertical (V) components – e.g., 2H:1V. Also note that according to international standards (Metric), the slopes are presented as the vertical or width component shown on the numerator--e.g., 1V:2H. Slope expressions in this handbook follow the common presentation of slopes - e.g., 2H:1V. Slopes can also be expressed in "percent" or “degrees.” Slopes given in percents are always expressed as (V/H) - e.g., a 2H:1V (1V:2H) slope is a 50% slope. The term gradient is also used.

Slope Protection - The protection of a slope against wave action or erosion.

Slough(ing) - The separation from the surrounding material and downhill movement of a small portion of the slope. Usually a slough refers to a shallow earth slide.

Sluiceway - See Low-Level Outlet.

Soil - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Also see Alluvial Soils, Clay, Cohesive Soil, Loam, Permeability (soil), Sand, Silt, Soil Horizon, Soil Profile, Subsoil, Surface Soil, Topsoil.

Soil Horizon - A horizontal layer of soil that, through processes of soil formation, has developed characteristics distinct from the layers above and below.

Soil Profile - A vertical section of the soil from the surface through all horizons.

Soil Structure -The relation of particles that impact to the whole soil a characteristic manner of breaking - e.g., crumb, block, platy, or columnar structure.

Soil Texture - The physical structure or character of soil determined by the relative proportions of the soil separates (sand, silt, and clay) of which it is composed.

Spalling - Breaking (or erosion) of small fragments from the surface of concrete masonry or stone under the action of weather or abrasive forces.

Specific Gravity - The ratio of (1) the weight in air of a given volume of soil solids at a stated temperature to (2) the weight in air of an equal volume of distilled water at a stated temperature.

Spillway (Spillway System) - A structure or structures over or through which reservoir flows are discharged. Spillways are provided in dams to release normal and surplus water or floodwater that cannot be contained in the allotted reservoir storage space. If the flow is controlled by gates, it is a controlled spillway; if the elevation of the spillway crest is the only control, it is an uncontrolled spillway.

Stilling Basin - A basin constructed to dissipate the energy of fast-flowing water, e.g., from a spillway or bottom outlet, and to protect the streambed from erosion.

Stoplogs - Wooden boards, timber, or steel beams or panels spanning horizontally between slots or grooves recessed in the sides of supporting piers placed on top of each other with their ends held in guides on each side of a channel or conduit providing a temporary closure versus a permanent bulkhead gate.

Storm Event - An estimate of the expected amount of precipitation within a given period of time. For example, a 10-yr. frequency, 24-hr duration storm event is a storm that has a 10% probability of occurring in any one year. Precipitation is measured over a 24-hr period.

Storm Frequency - The time interval between major storms of predetermined intensity and volumes of runoff - e.g., a 5-yr, 10-yr. or 20-yr storm.

Stormwater Runoff - The water derived from rains falling within a watershed or drainage area, flowing over the surface of the ground or collected in channels or conduits.

Storm Sewer - A sewer that carries stormwater, surface drainage, street wash, and other wash waters but excludes sewage and industrial wastes. Also called a storm drain.

Stream - See Intermittent Stream, Perennial Stream, Receiving Stream.

Streambanks - The usual boundaries (not the flood boundaries) of a stream channel. Right and left banks are named facing downstream.

Structural Joint - A joint constructed where movement of a part of a structure, due to temperature or moisture variations, settlement, or any other cause, would result in harmful displacement of adjoining structural components.

Subarea/Subbasin - Portion of a watershed divided into homogenous drainage units which can be modeled for purposes of determining runoff rates. The subareas/subbasins have distinct boundaries, as defined by the topography of the area.

Subsoil - The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below which roots do not normally grow.

Subsurface Drain - A pervious backfilled trench, usually containing stone and perforated pipe, for intercepting groundwater or seepage.

Subwatershed - A watershed subdivision of unspecified size that forms a convenient natural unit. See also Subarea.

Surface Runoff - See Runoff.

Surface Soil - The uppermost part of the soil ordinarily moved in tillage or its equivalent in an uncultivated soil. Frequently referred to as the plow layer. Surface soil is usually darker in color due to the presence of organic matter.

Suspended Solids - Solids either floating or suspended in water.

Swale - An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales conduct stormwater into primary drainage channels and may provide some groundwater recharge.

Tailwater - The water surface elevation at the downstream side of a hydraulic structure (i.e. culvert, bridge, weir, dam, etc.).

Time of Concentration (tc) - Is the travel time of a particle of water from the most hydraulically remote point in the contributing area to the point under study. This can be considered the sum of an overland flow time and times of travel in street gutters, storm sewers, drainage channels, and all other drainage ways.

Toe of Dam - The lowermost portion of the dam embankment where the embankment intersects the ground surface. Also referred to as "downstream toe" or "upstream toe."

Toe of Slope - The base or bottom of a slope at the point where the ground surface abruptly changes to a significantly flatter grade.

Top of Dam - The elevation of the uppermost surface of a dam excluding any parapet wall, railings, etc.

Topographic Map - Graphical portrayal of the topographic features of a land area, showing both the horizontal distances between the features and their elevations above a given datum. Elevations are typically shown with contour lines.

Topography - The representation of a portion of the earth's surface showing natural and man-made features of a give locality such as rivers, streams, ditches, lakes, roads, buildings and most importantly, variations in ground elevations for the terrain of the area.

Topsoil - (1) The dark-colored surface layer, or A horizon, of a soil; when present it ranges in depth from a fraction of an inch to 2-3 ft. (2) Equivalent to the plow layer of cultivated soils. (3) Commonly used to refer to the surface layer(s), enriched in organic matter and having textural and structural characteristics favorable for plant growth.

Trash Rack - A screen located at an intake to prevent the ingress of debris. A trash rack is typically a structure of metal or reinforced concrete bars located at the intake of a waterway, designed to prevent entrance of floating or submerged debris of a certain size and larger.

Turbidity - (1) Cloudiness of a liquid, caused by suspended solids. (2) A measure of the suspended solids in a liquid.

Underdrain - A small diameter perforated pipe that allows the bottom of an embankment, detention basin, channel or swale to drain.

Unified Soil Classification System (USCS) - A system of classifying soils that is based on their identification according to particle size, gradation, plasticity index, and liquid limit.

Uniform Flow - A state of steady flow when the mean velocity and cross-sectional area remain constant in all sections of a reach.

Uplift - The upward pressure in the pores of a material (interstitial pressure) or on the base of a structure.

Valve - A device fitted to a pipeline or orifice in which the closure member is either rotated or moved transversely or longitudinally in the waterway so as to control or stop the flow.

Vegetative Stabilization - Protection of erodible or sediment producing areas with: permanent seeding (producing long-term vegetative cover), short-term seeding (producing temporary vegetative cover), or sodding (producing areas covered with a turf of perennial sod-forming grass).

Water Table - (1) The free surface of the groundwater. (2) That surface subject to atmospheric pressure under the ground, generally rising and failing with the season or from other conditions such as water withdrawal.

Watercourse - Any river, stream, creek, brook, branch, natural or man-made drainageway in or into which stormwater runoff or floodwaters flow either continuously or intermittently.

Watershed - The region drained by or contributing water to a specific point that could be along a stream, lake or other stormwater facilities. Watersheds are often broken down into subareas for the purpose of hydrologic modeling.

Watershed Area - All land and water within the confines of a drainage divide. See also Watershed.

Weep Holes - Openings left in retaining walls, aprons, linings, or foundations to permit drainage and reduce pressure.

Waterstop - A strip of metal, rubber, or other material used to prevent leakage through joints between adjacent sections of concrete.

Weir - A channel-spanning structure for measuring or regulating the flow of water. A type of spillway in which flow is constricted and caused to fall over a crest. Types of weirs include broad-crested weir, ogee weir, v-notch weir, sharp-crested weir, drowned weir, and submerged weir.

Weir Notch - The opening in a weir for the passage of water.

Wetlands - Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions and/or those wetland areas that are under the USACE jurisdiction.